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(51) INT CL^6
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H1K KMBX

(56) Documents Cited
Patent Abstracts of Japan E1535,8/4/94,Vol.18 Number 202 page 56 and JP 6-6077(TAIYO YUDEN)
Patent Abstracts of Japan E1535,8/4/94,Vol.18 Number 202 page 56 and JP 6-6079(TAIYO YUDEN)
Patent Abstracts of Japan E1027,29/1/91,Vol.15 Number36 page 61 and JP 2-274000(SANYO)

(58) Field of Search
UK CL (Edition O) H1K KMBX
INT CL^6 H01L
ON LINE,W.P.I.

(54) Systems for surfacing mounting components.

(57) The system includes a plurality of feeders, each feeder (12) being respectively identified by a first bar-code label and holding a component reel identified by a second bar-code label. At least one bar code scanner (16, 18) is provided. The first and second bar-code labels are scanned automatically by the at least one bar code scanner (16, 18). A component part number is then assigned to the respective first feeder number to prevent the placement of wrong components. The system also includes a sensor array for sensing the position of a feeder and makes a comparison between the sensed position and part number, and stored valves of these parameters. Any error causes the system to be turned off.

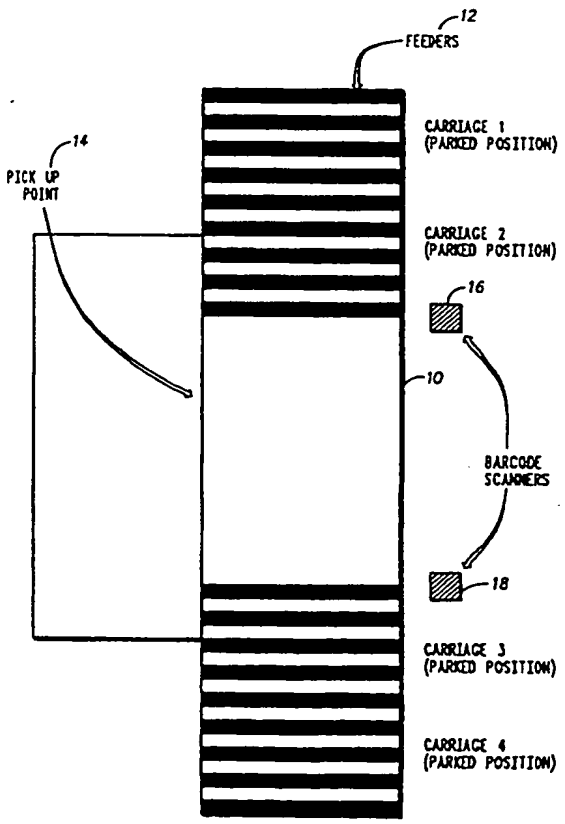

FIG.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

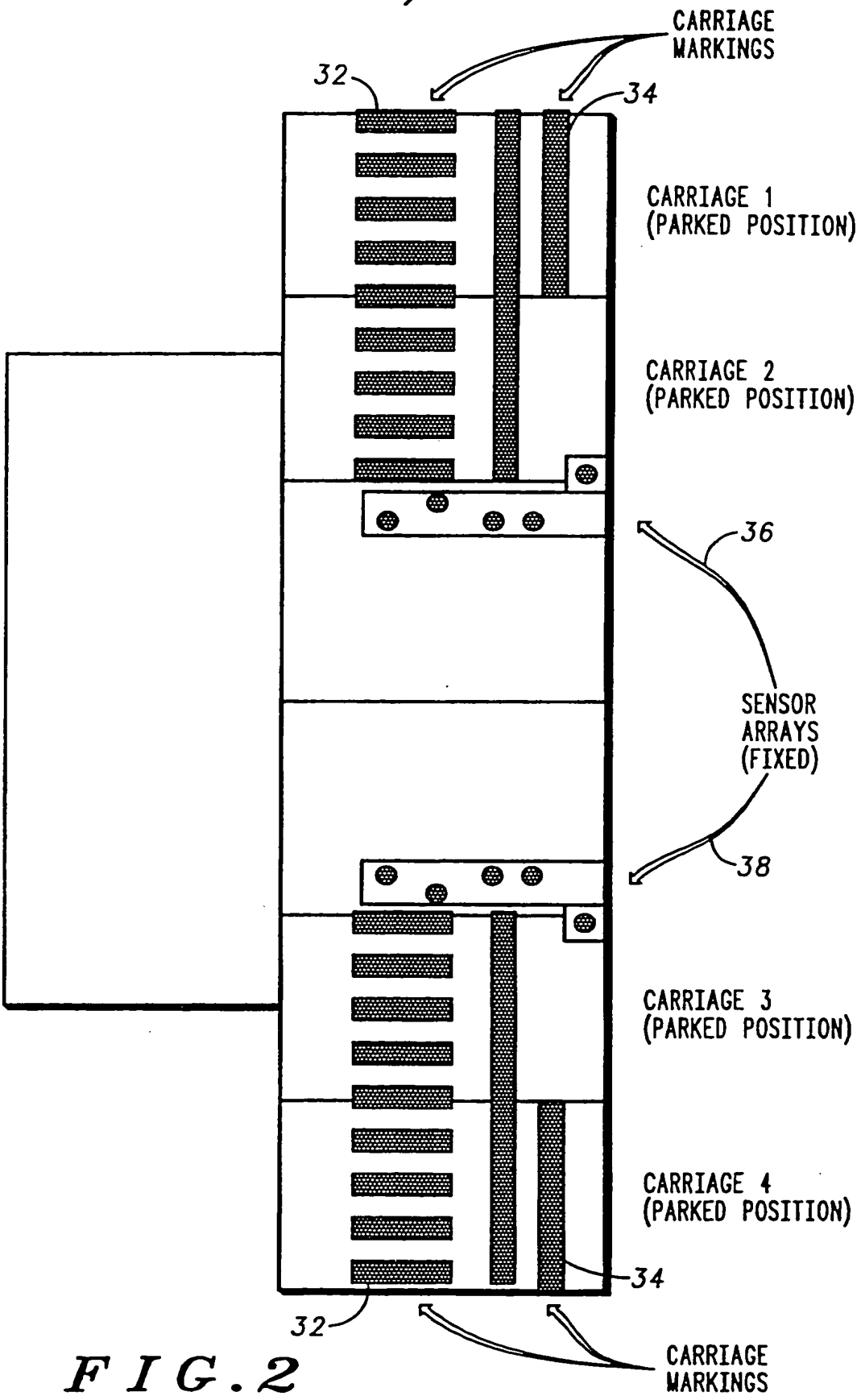
CARRIAGE MARKINGS
32
34
CARRIAGE 1 (PARKED POSITION)
CARRIAGE 2 (PARKED POSITION)
36
SENSOR ARRAYS (FIXED)
38
CARRIAGE 3 (PARKED POSITION)
CARRIAGE 4 (PARKED POSITION)
34
32
CARRIAGE MARKINGS

FIG. 2

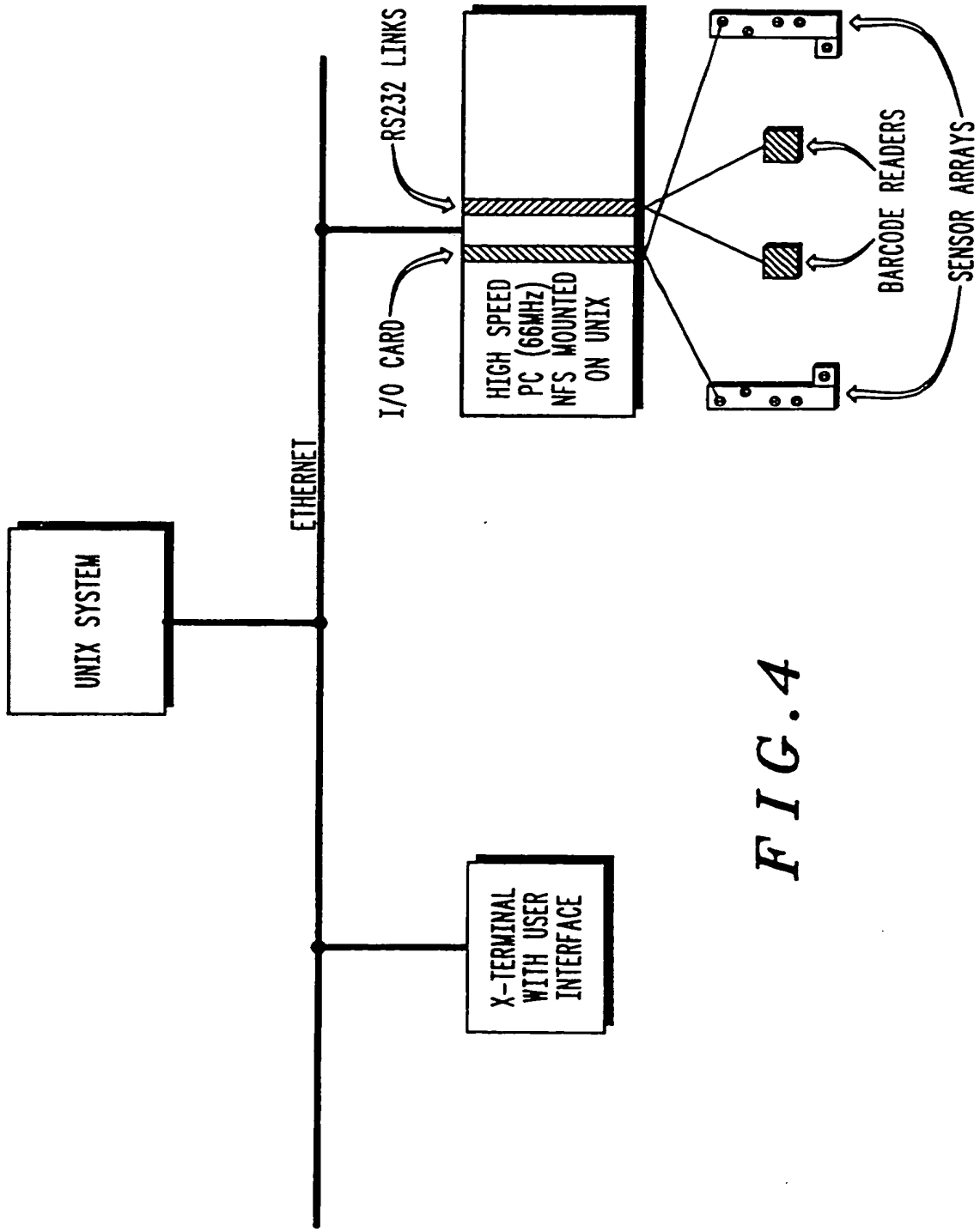
UNIX SYSTEM
ETHERNET
X-TERMINAL WITH USER INTERFACE
I/O CARD
RS232 LINKS
HIGH SPEED PC (66MHz) NFS MOUNTED ON UNIX
BARCODE READERS
SENSOR ARRAYS

FIG.4

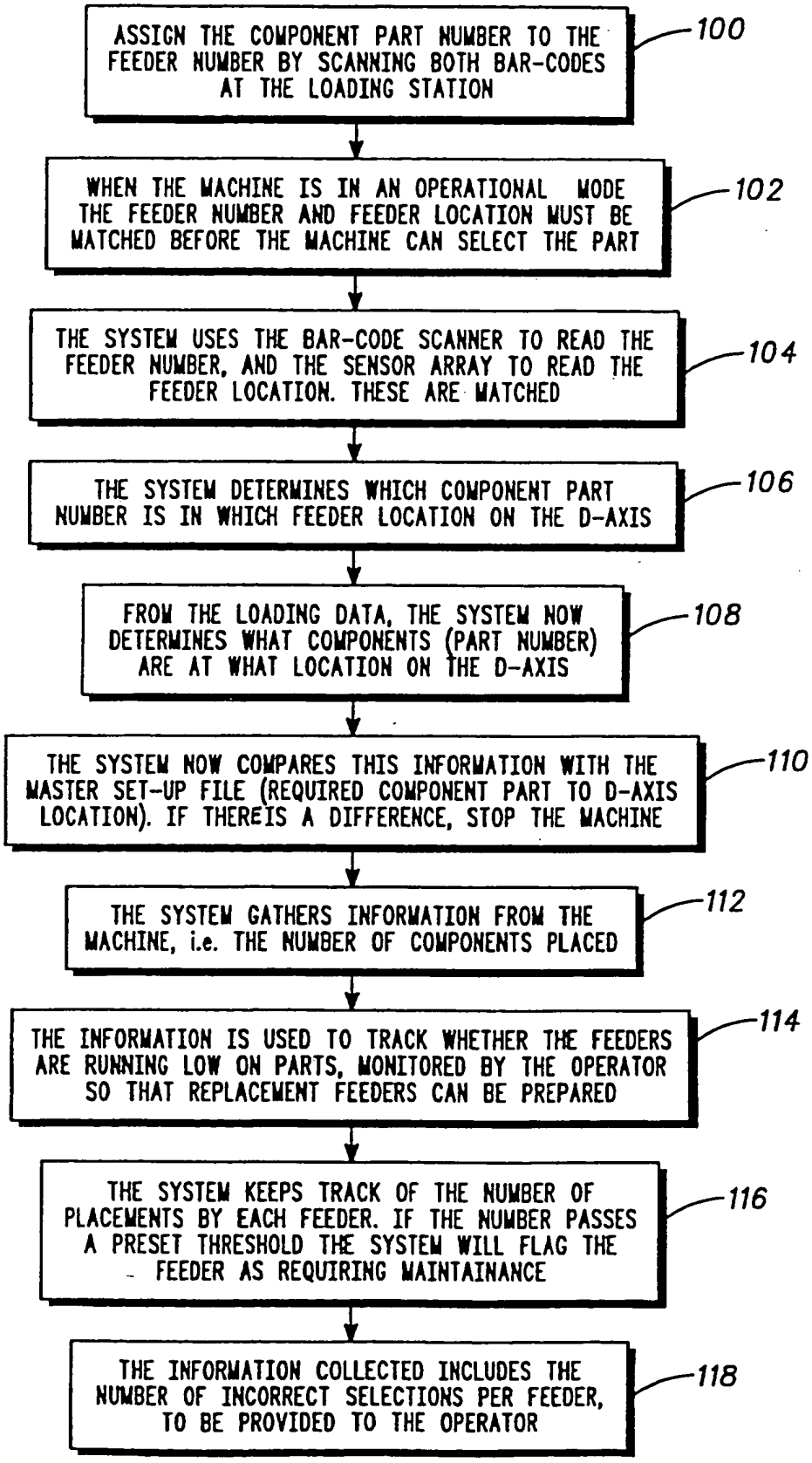
ASSIGN THE COMPONENT PART NUMBER TO THE FEEDER NUMBER BY SCANNING BOTH BAR-CODES AT THE LOADING STATION
100
WHEN THE MACHINE IS IN AN OPERATIONAL MODE THE FEEDER NUMBER AND FEEDER LOCATION MUST BE MATCHED BEFORE THE MACHINE CAN SELECT THE PART
102
THE SYSTEM USES THE BAR-CODE SCANNER TO READ THE FEEDER NUMBER, AND THE SENSOR ARRAY TO READ THE FEEDER LOCATION. THESE ARE MATCHED
104
THE SYSTEM DETERMINES WHICH COMPONENT PART NUMBER IS IN WHICH FEEDER LOCATION ON THE D-AXIS
106
FROM THE LOADING DATA, THE SYSTEM NOW DETERMINES WHAT COMPONENTS (PART NUMBER) ARE AT WHAT LOCATION ON THE D-AXIS
108
THE SYSTEM NOW COMPARES THIS INFORMATION WITH THE MASTER SET-UP FILE (REQUIRED COMPONENT PART TO D-AXIS LOCATION). IF THERE IS A DIFFERENCE, STOP THE MACHINE
110
THE SYSTEM GATHERS INFORMATION FROM THE MACHINE, i.e. THE NUMBER OF COMPONENTS PLACED
112
THE INFORMATION IS USED TO TRACK WHETHER THE FEEDERS ARE RUNNING LOW ON PARTS, MONITORED BY THE OPERATOR SO THAT REPLACEMENT FEEDERS CAN BE PREPARED
114
THE SYSTEM KEEPS TRACK OF THE NUMBER OF PLACEMENTS BY EACH FEEDER. IF THE NUMBER PASSES A PRESET THRESHOLD THE SYSTEM WILL FLAG THE FEEDER AS REQUIRING MAINTAINANCE
116
THE INFORMATION COLLECTED INCLUDES THE NUMBER OF INCORRECT SELECTIONS PER FEEDER, TO BE PROVIDED TO THE OPERATOR
118

FIG. 6

operating the information is read real-time. The IPC system is restricted to the new Panasonic Chipshooters and requires particular feeders that are compatible with the IPC module. Such a system is renowned as expensive. It also assumes that the set-up file on the Chipshooter has up-to-date information on the actual d-axis set-up of the manufacturing process.

This invention seeks to provide an improved and flexible manufacturing apparatus and process.

Summary of the Invention

In a first aspect of the present invention, a method for controlling feeders in a chipshooter manufacturing system is provided. The chipshooter manufacturing system includes a plurality of feeders, each feeder of the plurality of feeders respectively identified by a first bar-code label and holding a component reel identified by a second bar-code label. The chipshooter manufacturing system includes at least one bar code scanner. The method includes the steps of scanning the first bar-code label of a respective first feeder automatically by the at least one bar code scanner, scanning the second bar-code label of the respective first component reel by the at least one bar code scanner and assigning a component part number to the respective first feeder number.

Preferably, the chipshooter manufacturing system includes a sensor array and the method further includes the steps of sensing a position of the first feeder in at least one plane by the sensor array and determining a component part number for the position of the first feeder in the at least one plane. In the preferred embodiment of the invention, the at least one plane is a d-axis of the chipshooter manufacturing system and at least one terminal is operably coupled to a controller and to the manufacturing system via at least one interface element and a data communication link.

In this manner, the correct component for the correct feeder is checked, together with monitoring the correct position of the feeder/component reel in the chipshooter manufacturing system. Furthermore, the component part number and position of the first feeder is compared with a stored component part number and stored position in a master record of the at least one terminal to determine whether the chipshooter manufacturing system is ready for correct operation. If there are any errors, the chipshooter manufacturing system will be

FIG. 4 is a diagram of an architecture of a manufacturing system according to the preferred embodiment of the invention.

FIG. 5 is a timing diagram showing signals transmitted from two sensors to a P.C. according to the preferred embodiment of the invention.

Detailed Description of the Drawings

Referring first to FIG. 1, a diagram of a Chipshooter (top view) of a manufacturing system, according to a preferred embodiment of the invention, is shown. The Chipshooter 10 holds a number of feeders 12. The Chipshooter is divided into a number of carriages; four carriages in the example shown. The feeders 12 contain reels of components, each individually defined by a bar-code label, and the feeders 12, also individually defined by a bar-code label, are so arranged that they pass either a first bar-code scanner 16 or a second bar-code scanner 18, positioned at the side of the Chipshooter 10, before components are picked from each feeder. The chosen feeder, with the desired reel of components, is positioned at the pick-up point 14. It is within the contemplation of the invention that only one bar-code scanner may be used to fulfil the scanning operation in both directions

Referring now to FIG. 2, a diagram of the bottom view of the Chipshooter of the manufacturing system of FIG. 1, according to the preferred embodiment of the invention, is shown. The feeders 12 are defined by first carriage markings indicative of the feeder pitch 32 and second carriage markings 34 to indicate the carriage number. Preferably, the carriage markings are monitored by a first sensor array 36 to read the carriage position and a second sensor array 38 to read the carriage number, although it is within the contemplation of the invention that only one sensor array may be used to fulfil both functions.

Referring now to FIG. 3 a more detailed diagram of the bottom view of the Chipshooter of FIG. 2, is shown. The first carriage markings indicative of the feeder pitch 32 and second carriage markings 34 are shown monitored by the first sensor array 36. The first sensor array 36 has five sensors associated with each of the bar-code readers. These are optic fibre sensors which switch when their light is reflected (white surface). They have a very low switching time of 200 microseconds which is needed for the speed of the carriages, as shown in FIG. 3. Two sensors are used to identify the Carriage (by using black or white strips), e.g. a first carriage

Therefore the ideal location for the scanners in this case is just as the carriages go from the parked position into the working position, as shown in FIG. 1 and FIG. 2. As the carriages move past the scanners at very high speed the scanners must be of very high speed, e.g. 1 Carriage with up to 40 feeders in 1.5 sec. Tests showed that there was not bar-code scanner on the market which could match this speed. Our solution was to use the highest speed PC available as a buffer between the scanners and the application (on the UNIX). The solution was 2 x Intermec MS 4200 STD scanners connected to a Dell 486 66 MHz PC.

It is within the contemplation of the invention that the manufacturing system described is the preferred embodiment of the invention and that the scope of the invention applies to any variants of the elements and processes, or indeed the orientation or number of said elements and processes described herein.

Referring now to FIG. 4, a diagram of an architecture of a manufacturing system, according to the preferred embodiment of the invention, is shown.

In operation, the PC is NFS (Network File System) mounted on the UNIX system, giving it a remote hard disk on the UNIX system. This eliminates the complications and time delays introduced by communication protocols. All information transfer is done via files which are readable from the UNIX application and the PC. The main set-up files are maintained on the UNIX system and it is against this, that the d-axis is checked. All data loading and user interface is via the x-terminal which accesses data directly on the UNIX system.

All feeders are bar-coded. On feeder loading, the operator scans the feeder number and the P/N bar-codes, thereby assigning a P/N to a feeder. There are two high speed bar-code scanners mounted on the back of the Sanyo 1000. No vendor system was found which was fast enough to match the speed of the d-axis moving. A 486 PC (66 MHz) is used to buffer the data from the scanners, to match the speed of the machine. The scanners read the feeder bar-codes every time the machine restarts, after an error occurred or after the machine has been stopped. The PC compares the data with a set-up file mounted on the CAM system. If there is a difference a signal will be sent to the machine, thereby stopping the machine before a wrong component has been placed.

The PC is NFS mounted on the CAM UNIX system thereby eliminating the need to upload and download data. The system also tracks

preventative maintenance checks, tracking feeder reject rate and highlighting problem feeders to the operator, informing the operator when a feeder is running low and allowing them to prepare replacement feeders, is provided.

Thus a manufacturing apparatus and method of operation are provided that are an improvement over, and more flexible than, prior art manufacturing systems and processes.

5. The method for controlling feeders in a chipshooter manufacturing system in accordance with any one of the preceding claims, the method further comprising the steps of:

comparing the respective component part number and position of the respective first feeder with a stored component part number and stored position in a master record of the at least one terminal to determine whether the chipshooter manufacturing system is ready for correct operation.

6. The method for controlling feeders in a chipshooter manufacturing system in accordance with claim 5, the method further comprising the steps of:

stopping operation of the chipshooter manufacturing system automatically when there exists a difference between the respective component part number and position of the first feeder with the stored number and stored position in the master record of the at least one terminal.

7. The method for controlling feeders in a chipshooter manufacturing system in accordance with any one of the preceding claims, the method further comprising the step of:

tracking automatically a number of components held on a component reel on a respective first feeder to determine whether the number of components is below a threshold value indicating that the component reel needs to be replaced.

8. The method for controlling feeders in a chipshooter manufacturing system in accordance with any one of the preceding claims, the method further comprising the step of:

tracking automatically a number of placements by each feeder of the plurality of first feeders to determine whether the number of placements of a respective first feeder is above a threshold value indicating that the respective first feeder requires a maintenance check.

The Patent Office

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Claims searched:	All	**Date of search:**	4 December 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H1K(KMBX)

Int Cl (Ed.6): H01L

Other: ON LINE,W.P.I.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	Patent Abstracts of Japan E1535,8/4/94,Vol.18 Number 202 page 56 and JP 6-6077(TAIYO YUDEN)	
A	Patent Abstracts of Japan E 1535,8/4/94,Vol.18 Number 202 page 56 andJP 6-6079(TAIYO YUDEN)	
A	Patent Abstracts of Japan E 1027,29/1/91,Vol.15 Number 36 page 61 and JP 2-274000(SANYO)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.